

SECTION 301 LIME TREATED SUBGRADE:

301-1 Description:

The work under this section shall consist of preparing roadbed for lime treatment, furnishing and applying lime, mixing lime and water with in-place material, and spreading, compacting and curing the mixture to the lines, grades and dimensions shown on the project plans and in accordance with the requirements of these specifications.

301-2 Materials:

301-2.01 Lime:

Lime shall be either a commercial dry hydrated lime or a commercial granular or pelletized quicklime, conforming to the requirements of ASTM C 51. When sampled on delivery, the sample of lime shall conform to the following gradations:

Sieve Size	Percent Passing	
	Hydrated Lime	Quicklime
3/4 inch	100	100
No. 30	95 - 100	
No. 100		0 - 30
No. 200	75 - 100	
Test Method	ASTM C 110	ASTM C 136 (Dry sieving only)

Hydrated lime shall contain not less than 85 percent calcium hydroxide, Ca(OH)_2 , as determined by ASTM C 25.

Quicklime shall contain not less than 94 percent total available calcium oxide and magnesium oxide ($\text{CaO} + \text{MgO}$), and not less than 90 percent total available calcium oxide (CaO), as determined by ASTM C 25.

Lime from more than one source or more than one type may be used on the same project, but the different limes shall not be mixed. The lime shall be protected from exposure to moisture until used and shall be sufficiently dry to flow freely when handled.

The type of lime will be specified in the Special Provisions.

301-2.02 Water:

Water used for mixing shall conform to the requirements of Subsection 1006-2.02.

301-2.03 Bituminous Material for Curing Seal:

Bituminous material for curing seal shall be Emulsified Asphalt, Grade SS-1 conforming to the requirements of Section 1005.

301-3 Construction Requirements:

301-3.01 Preparation of Roadbed:

In-place material to be lime treated shall be scarified and thoroughly broken up to the full roadway width. The material to be treated shall contain no rocks larger than 2-1/2 inches in any dimension. The depth to be scarified shall be such that when the lime, water and in-place material is mixed and compacted, the treated subgrade will be in close conformity to the specified thickness.

If the mixing machine to be used requires that the material be windrowed, the windrows shall be of uniform cross section and limited to such size that all the material can be passed through the mixer at each operation. Otherwise the material shall be shaped to the required line, grade and cross section before application of lime and mixing.

301-3.02 Application of Lime:

Lime shall be added to the material to be treated at a rate not varying more than 10 percent from the rate specified in the Special Provisions. The equipment used to distribute the lime shall be approved by the Engineer and it shall be capable of uniformly distributing the required amount of lime for the full width of the pass.

Lime or lime treated material shall not be spread or mixed when the soil is frozen, when the air temperature is less than 40 degrees F in the shade, or when conditions indicate that the temperature may fall below 40 degrees F within 24 hours.

The area upon which lime may be spread ahead of the mixing operation shall be limited to that which the contractor may thoroughly mix by the end of the working day.

No traffic other than water trucks and the mixing equipment shall be allowed to pass over the spread lime until after completion of mixing.

301-3.03 Mixing:

Mixing shall be accomplished by a traveling pugmill or a single or multiple transverse shaft mixer and shall be approved by the Engineer. It shall be equipped with a system capable of introducing water at a controlled rate during mixing in order to produce a completed mixture with a uniform moisture content within two percentage points of the optimum moisture content of the material being treated. The optimum moisture content will be determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer.

Mixing or re-mixing operations shall continue until the material is uniformly mixed, free of streaks or pockets of lime. The final mixture shall not contain more than five percent of untreated dirt clods larger than one inch in diameter.

After the initial mixing operation and before the lime treated material is compacted, a curing period of 24 to 48 hours will be required.

If quicklime is used for subgrade treatment, sufficient water shall be added prior to or during initial mixing to slake all of the quicklime.

301-3.04 Compaction and Finishing:

The treated mixture shall be spread and compacted to the required width, grade and cross section.

The thickness of a compacted layer shall not exceed eight inches. Where the required thickness is more than eight inches, the mixture shall be spread and compacted in two or more approximately equal lifts. The moisture content shall be maintained to achieve compaction. Unless specified otherwise, the lime treated material shall be compacted to a density of at least 100 percent of the maximum density as determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer.

Initial compaction shall be by means of sheepfoot or grid rollers. Final compaction shall be by means of steel wheel or pneumatic tired rollers. Areas inaccessible to rollers shall be compacted to the required density by other means satisfactory to the Engineer.

The lime treated subgrade shall be finished to a reasonably smooth and uniform surface and in reasonably close conformity to the lines, grades, dimensions and cross sections shown on the project plans or established by the Engineer. The treated subgrade shall not vary by more than 0.04 feet above or below the grade established by the Engineer.

Damage to the lime treated subgrade which occurs as a result of the contractor's construction activities shall be promptly repaired by the contractor at no additional cost to the Department, when so directed by the Engineer.

301-3.05 Curing:

The surface of each compacted layer of lime treated material shall be kept moist until covered by a subsequent layer of lime treated material, or until a bituminous curing seal is applied. The bituminous curing seal shall be applied uniformly at an approximate rate of 0.15 gallons per square yard of surface, the exact rate to be determined by the Engineer in accordance with the requirements of Subsection 404-3.05. The curing seal shall be applied as soon as possible after the completion of final compaction and before the temperature falls below 35 degrees F.

No equipment or traffic will be permitted on lime treated subgrade for three days after curing seal is applied, unless otherwise permitted by the Engineer. Subsequent subbase, base or pavement course shall be placed within 10 days after the curing seal is applied.

Any damage to the curing seal or lime treated subgrade shall be promptly repaired by the contractor at no additional cost to the Department and as directed by the Engineer, until a subsequent subbase, base or pavement course is placed over the lime treated subgrade.

301-3.06 Safety Program:

The contractor shall provide to the Engineer for review a detailed safety program for the protection of the workers and public, covering precautions to be exercised and emergency treatment to be available on the project site. The program shall include protective equipment for eye, mouth, nose, and skin protection; and a first aid kit with an eyeball wash. Said protective equipment shall be available on the project site during spreading and mixing operations. This program shall be provided and agreed upon before the lime spreading begins. The contractor shall actively enforce the program for the protection of its work force and others in the construction area. Adequate care must be taken to avoid quicklime contact during spreading and slaking operations.

301-4 Method of Measurement:

Hydrated lime or quicklime will be measured by the ton in accordance with the requirements of Section 109.

Subgrade treatment will be measured by the square yard of subgrade treated. The area will be determined from horizontal measurements of the surface area treated, excluding any side slopes of the treated section.

301-5 Basis of Payment:

The accepted quantities of lime and subgrade treatment, measured as provided above, will be paid for at the contract unit prices per ton for hydrated lime or quicklime, and per square yard for subgrade treatment, complete in place.

Payment for lime will include furnishing and application of lime.

Payment for lime treated subgrade will also include furnishing and application of curing seal.

SECTION 302 CEMENT TREATED SUBGRADE:

302-1 Description:

The work under this section shall consist of preparing the roadbed for cement treatment; furnishing and applying cement; mixing cement and water with in-place material; and

spreading, compacting and curing the mixture to the lines, grades and dimensions shown on the project plans and in accordance with the requirements of these specifications.

302-2 Materials:

302-2.01 In-place Material:

In-place material on the roadbed shall be the native material or embankment.

302-2.02 Hydraulic Cement and Water:

Hydraulic cement and water shall conform to the requirements of Subsection 1006-2.

302-2.03 Bituminous Material for Curing Seal:

Bituminous material for curing seal shall be Emulsified Asphalt, Grade SS-1 conforming to the requirements of Section 1005.

302-3 Construction Requirements:

302-3.01 Preparation of Roadbed:

In-place material which is to be cement treated shall be scarified and thoroughly broken up over the full roadway width. The material to be treated shall contain no rocks larger than 2-1/2 inches in any dimension. The depth to be scarified shall be such that when the cement, water and in-place material is mixed and compacted, the treated subgrade will be in reasonably close conformity to the specified thickness.

If the mixing operation requires that the material be windrowed, the windrows shall be of uniform cross section and limited to a size that will allow all the material to pass through the mixer in each operation. Otherwise the material shall be shaped to the required line, grade and cross section before application of cement and mixing.

302-3.02 Application of Cement:

Cement shall be added to the material to be treated at the rate specified in the Special Provisions. The actual application rate shall not vary by more than 10 percent from the rate specified. The equipment used to distribute the cement shall be as approved by the Engineer and it shall be capable of uniformly distributing the required amount of cement for the full width of the pass.

Cement or cement treated material shall not be spread or mixed when the soil is frozen, when the air temperature is less than 40 degrees F in the shade, or when conditions indicate that the temperature may fall below 40 degrees F within 24 hours.

The area upon which cement may be spread shall be limited to that which the contractor can thoroughly mix and compact by the end of one-half of a work shift.

No traffic other than water trucks and mixing equipment shall be allowed to pass over the spread cement until after completion of mixing.

302-3.03 Mixing:

Mixing shall be accomplished with a traveling pugmill or a single or multiple transverse shaft mixer as approved by the Engineer. Mixers shall be equipped with a system capable of introducing water at a controlled rate during mixing and be capable of producing a completed mixture with a uniform moisture content. The moisture content of the completed mixture shall be within two percentage points of the optimum moisture content of the material being treated as determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer.

The in-place material and cement shall be mixed such that cement balls are prevented from forming when water is added. Mixing shall be continued until the mixture is uniform and at the required moisture content.

302-3.04 Compaction and Finishing:

The thickness of a compacted layer shall not exceed eight inches. The moisture content shall be maintained to achieve compaction. Unless specified otherwise, the cement treated material shall be compacted to a density of at least 100 percent of the maximum density as determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer.

Initial compaction shall be accomplished with sheepsfoot or grid rollers. Final compaction shall be accomplished with steel-wheel or pneumatic-tired rollers. Areas inaccessible to rollers shall be compacted to the required density as approved by the Engineer.

The cement treated subgrade shall be finished to a reasonably smooth and uniform surface and in reasonably close conformity to the lines, grades, dimensions and cross sections shown on the project plans or established by the Engineer. The surface of the treated subgrade shall not vary by more than 0.04 feet above or below the grade established by the Engineer.

Damage to cement treated subgrade which occurs as a result of the contractor's construction activities shall be promptly repaired by the contractor at no additional cost to the Department, when so directed by the Engineer.

302-3.05 Operation Time Requirement:

Not more than two hours shall elapse between the time water is added to the subgrade and cement, and the time of completion of initial compaction prior to trimming. Not more than 2.5 hours shall elapse between the time water is added to the subgrade and cement and

the time of completion of final compaction after trimming, unless otherwise approved by the Engineer.

302-3.06 Curing:

The surface of cement treated subgrade shall be kept moist until a curing seal is applied. Bituminous curing seal shall be applied uniformly at the rate of 0.15 gallons per square yard of surface. The curing seal shall be applied on the same day that final compaction is performed and as soon after the final compaction as is practicable.

Any damage to the curing seal or the cement treated subgrade shall be promptly repaired by the contractor, at no additional cost to the Department and as directed by the Engineer.

After the curing seal has been applied, the cement treated subgrade shall be kept free of heavy equipment and traffic for a period of at least three days. Light construction traffic will be allowed after the curing seal has been placed. Subsequent subbase, base or pavement course shall be placed within 10 days after the curing seal is applied.

Any damage to the curing seal or cement treated subgrade shall be promptly repaired by the contractor at no additional cost to the Department and as directed by the Engineer, until a subsequent subbase, base or pavement course is placed over the cement treated subgrade.

When the project plans call for four inches or more of aggregate base over the cement treated subgrade, the aggregate base may be used as the curing seal in lieu of a bituminous curing seal. The aggregate base shall be kept moist for 72 hours. The section may be opened to traffic immediately after placement and compaction of the aggregate base.

302-4 Method of Measurement:

Cement for cement treated subgrade will be measured by the ton.

Cement treated subgrade will be measured by the square yard of subgrade treated. The area will be determined from horizontal measurements of the surface area treated, excluding any side slopes of the treated section.

302-5 Basis of Payment:

The accepted quantities of cement, measured as provided above, will be paid for at the contract unit price per ton of cement furnished and applied.

The accepted quantity of cement treated subgrade, measured as provided above, will be paid for at the contract unit price per square yard of subgrade treatment, complete in place, including furnishing and applying a bituminous curing seal when required.

SECTION 303 AGGREGATE SUBBASES AND AGGREGATE BASES:

303-1 Description:

The work under this section shall consist of furnishing, placing and compacting aggregate subbases and aggregate bases in accordance with the details shown on the project plans and the requirements of these specifications.

Aggregate subbases and aggregate bases are designated as Class 1 through Class 6. The class of aggregate subbase and aggregate base will be shown on the project plans or specified in the Special Provisions.

303-2 Materials:

Aggregate for the various classes of aggregate subbases and aggregate bases shall consist of stone, gravel or other approved inert material of similar characteristics, and shall be clean and free from vegetable matter and other deleterious substances.

Aggregate subbases and aggregate bases shall conform to the requirements shown in the following table for the class specified:

TABLE 303-1								
Class of Aggregate	Percent Passing Sieve (Inch or No.)							PI, Max.
	3	1-1/2	1	3/4	1/4	8	200	
1			100	90 - 100		35 - 55	0 - 8.0	3
2		100	90 - 100			35 - 55	0 - 8.0	3
3								
4	100				35 - 70		0 - 10.0	5
5	100				30 - 75		0 - 10.0	5
6								

Notes:

- (1) The percentage, by weight, passing each sieve will be determined in accordance with the requirements of Arizona Test Method 201.
- (2) The PI (Plasticity Index) will be determined in accordance with the requirements of AASHTO T 90.
- (3) Classes 1, 2 and 3 are bases; Classes 4, 5 and 6 are subbases.
- (4) The requirements for Class 3 and for Class 6 will be specified in the Special Provisions.
- (5) For Class 1 through Class 4 aggregate, the amount of fractured coarse aggregate particles shall be at least 30 percent, when tested in accordance with

TABLE 303-1	
	the requirements of Arizona Test Method 212.
(6)	Resistance to abrasion for Class 1 through Class 4 aggregate will be determined in accordance with the requirements of AASHTO T 96 and shall meet the following requirements:
	Maximum loss of 9 percent at 100 revolutions
	Maximum loss of 40 percent at 500 revolutions

When production of Class 1 through Class 4 aggregate requires composite mixing of materials from more than one source to meet the gradation requirements of Table 303-1, the material from each source shall meet the abrasion requirements specified in herein.

303-3 Construction Requirements:

303-3.01 Placement:

Aggregate subbases and aggregate bases shall have water added to them and shall be mixed and processed to produce a uniform blend of material before final placement. After processing, the material shall be placed and spread on the prepared subgrade, subbase or base in a uniform layer or layers not exceeding six inches in compacted depth, unless otherwise approved in writing by the Engineer. The method of dumping or spreading shall be determined by the contractor. The spread material shall be free of segregation.

303-3.02 Compaction:

Each layer of aggregate subbase and aggregate base shall be compacted to a density of not less than 100 percent of the maximum density determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer.

303-3.03 Finishing:

The final layer of subbase or base shall be finished with equipment capable of shaping and grading the finish surface within the tolerances specified herein.

The finished surface of aggregate subbase or aggregate base shall not vary from the grades established by the Engineer by more than ± 0.04 feet.

The compacted layers of aggregate subbase and aggregate base shall be maintained in a condition satisfactory to receive any subsequent subbase, base or surfacing material or traffic, when so required.

Areas not within the allowable tolerance shall be corrected by scarifying, placing additional material, re-mixing, reshaping and re-compacting to the specified density and surface tolerance.

303-4 Method of Measurement:

The quantity of aggregate subbase and aggregate base will be calculated by the cubic yard in place, using plan dimensions.

303-5 Basis of Payment:

The accepted quantities of aggregate subbase and aggregate base, measured as provided above, will be paid for at the contract unit price per cubic yard for the class or classes involved, complete in place.

SECTION 304 CEMENT TREATED BASE:

304-1 Description:

The work under this section shall consist of furnishing and mixing aggregate, cement and water, and spreading, compacting and curing the mixture in accordance with the details shown on the project plans and the requirements of these specifications.

304-2 Materials:

304-2.01 Aggregate:

Aggregate shall conform to the requirements of Subsection 303-2 for Class 2 aggregate, unless otherwise specified in the Special Provisions.

304-2.02 Hydraulic Cement and Water:

Hydraulic cement and water shall conform to the requirements of Subsection 1006-2.

304-2.03 Bituminous Material for Curing Seal:

Bituminous material for curing seal shall be Emulsified Asphalt Grade SS-1 conforming to the requirements of Section 1005.

304-2.04 Mix Design:

The contractor shall determine the mix proportions and shall furnish cement treated base conforming to the requirements specified herein. The job-mix design with the supporting test results shall be submitted to the Engineer and the Engineer's approval shall be obtained prior to incorporating any of the material into the work. The brand of cement and the location of the aggregate source shall be included with the job mix design data. A new

mix design shall be submitted for approval any time the contractor requests a change in materials or proportioning of the materials from that given in the approved mix designs.

Unless otherwise specified, cement treated base shall contain no less than 165 pounds of hydraulic cement per cubic yard, and it shall attain a minimum compressive strength of 500 pounds per square inch at seven days.

304-3 Construction Requirements:

304-3.01 Preparation of Subgrade:

Cement treated base shall be placed on a prepared subgrade which shall have been constructed in accordance with the surface finish and grade tolerance requirements specified for the subgrade material involved.

The subgrade shall be free of loose or extraneous material and maintained in an acceptable condition throughout the treatment operation. Any soft or yielding areas of the subgrade shall be corrected prior to placement of cement treated base.

304-3.02 Mixing:

(A) General Requirements:

Aggregate and cement for cement treated base shall be proportioned and mixed in a central mixing plant, unless otherwise specified. The plant shall be either the batch-mixing type using revolving blade or rotary drum mixers, or the continuous mixing type. The aggregate and cement may be proportioned either by weight or by volume.

Water shall be proportioned by weight or volume and there shall be means by which the Engineer may readily verify the amount of water required per batch or the rate of water flow required for continuous mixing. The time of the addition of water or the points at which it is introduced into the mixer shall be as approved by the Engineer.

The moisture content of the completed mixture shall be uniform and within two percentage points of the optimum at the point of delivery to the work. The optimum moisture content will be determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer.

The cement shall be added in such a manner that it is uniformly distributed throughout the aggregate during the mixing operation. There shall be safe, convenient facilities for sampling the cement in the supply line to the weigh hopper or pugmill.

The charge in the batch mixer or the rate of feed to the continuous mixer shall not exceed that which will permit complete mixing of all of the mix material.

(B) Batch Mixing:

The mixer shall be equipped with a sufficient number of paddles of a type and arrangement which will produce a uniformly mixed batch.

The mixer shall be equipped with an accurate timing device which will indicate by a definite audible or visual signal the expiration of the mixing period.

The time of mixing a batch shall begin after all ingredients are in the mixer and shall end when the mixer is half emptied. Mixing shall continue until a homogeneous mixture of uniformly distributed and properly coated aggregate of unchanging appearance is produced. The time of the mixing shall not be less than 30 seconds.

The batch-mixing plant shall be equipped with sampling facilities as approved by the Engineer. The sampling facilities shall allow for the easy and safe collection of representative samples of aggregate and cement treated base mixture.

(C) Continuous Mixing:

Aggregate shall be drawn from the storage facility by a feeder or feeders which will continuously supply the correct amount of aggregate in proportion to the cement.

A control system shall be provided that will automatically close down the plant when the material in any storage facility approaches the strike-off capacity of the feed gate. The plant will not be permitted to operate unless this automatic control system is in good working condition.

The feeder for the aggregate shall be mechanically or electrically driven.

Continuous mix plants shall be equipped with sampling facilities approved by the Engineer.

The sampling facilities shall allow for the easy and safe collection of representative samples of aggregate and cement treated base mixture.

The cement feeder and the aggregate feeders shall be equipped with devices by which the rate of feed can be accurately determined while the plant is in full operation.

(D) Spreading:

Mixed material shall be transported from the plant to the roadway in approved vehicles and spread on a moistened subgrade in a uniform layer for the full width of the base under construction. Mixed material may be placed in partial widths as approved by the Engineer. Spreading shall be accomplished with approved spreader boxes or finishing machines or motor graders. If the Engineer approves the use of one spreader operating alternately on two or more lanes, not more than 30 minutes shall elapse between the time of placing the material in adjacent lanes at any location. The material shall be spread full depth in one pass unless otherwise specified.

Cement treated base shall not be mixed or placed while the air temperature is below 40 degrees F in the shade or when conditions indicate that the temperature may fall below 40 degrees F within 24 hours. Cement treated base shall not be placed on frozen subgrade or mixed when the aggregate is frozen.

304-3.03 Compacting and Finishing:

Initial compaction shall begin immediately after spreading. Successive passes of compacting equipment shall overlap the previous adjacent pass by at least 25 percent of its width. Following initial compaction and before final compaction, the treated material shall be trimmed by blading with a motor grader or a planing machine to obtain surface in reasonably close conformity with the lines, grades and cross sections established or shown on the project plans.

Extreme care shall be exercised by the contractor during the trimming operation so that no more material than is necessary is disturbed and so that the trimming operation can be completed as quickly as possible. Trimmed material shall be wasted if so directed. Compaction shall proceed without interruption, except as stated above, to achieve at least 100 percent of maximum density as determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer.

The finished surface of cement treated base shall be uniform and shall not deviate at any point more than 0.03 feet from the bottom of a 10-foot straightedge laid in any direction.

The surface of the finished cement treated base shall not vary more than 0.04 feet above or below the grade established by the Engineer.

The surface shall be kept moist at all times until the curing seal is applied.

304-3.04 Operation Time Requirement:

Not more than two hours shall elapse between the time water is added to the aggregate and cement, and the time of completion of initial compaction prior to trimming. Not more than 2.5 hours shall elapse between the time water is added to the aggregate and cement and the time of completion of final compaction.

304-3.05 Construction Joints:

At the end of each day's work or when cement treated base operations are delayed or stopped for more than two hours, a construction joint shall be made in thoroughly compacted material. The joint shall be normal to the center line of the roadbed and have a vertical face. Additional mixture shall not be placed until the construction joint has been approved by the Engineer.

When partial-width construction of cement treated base is allowed and when the material has been finally compacted more than one hour, a longitudinal joint shall be constructed by

cutting back into the previously placed material to a point where it meets the proper line and grade, and trimmed to a true vertical face which is free of any loose or shattered material. Trimmed material shall be disposed of.

The face of transverse and longitudinal construction joints shall be moistened prior to placement of the adjacent base material.

304-3.06 Curing Seal:

After final compaction, the cement treated base shall be covered with a bituminous curing seal, applied uniformly to the surface at an approximate rate of 0.15 gallons per square. The curing seal shall be applied on the same day that final compaction is performed and as soon after the compaction as is practicable.

After the curing seal has been applied, the cement treated base shall be kept free of traffic for a period of at least three days. Only light construction traffic will be allowed from the fourth through the seventh day after the curing seal has been placed. Subsequent subbase, base or pavement course shall be placed within 10 days after the curing seal is applied.

Any damage to the curing seal or the cement treated base shall be promptly repaired by the contractor, at its expense and as directed by the Engineer.

When the project plans call for four or more inches of aggregate base over the cement treated base, the aggregate base may be used as the curing seal in lieu of a bituminous curing seal. The aggregate base shall be kept moist for 72 hours after placement. The section may be opened to traffic immediately after placement and compaction of the aggregate base.

304-3.07 Cement Treated Base Strength Tests:

Samples for strength tests will be taken at random for each lot of production. A lot shall be considered to be the production during one shift. Each lot shall be represented by five random samples, each sampled and tested in accordance with Arizona Test Method 241. The mean value of the sample strengths will be reported to the nearest pound per square inch.

304-4 Method of Measurement:

Cement treated base will be measured by the ton.

304-5 Basis of Payment:

The accepted quantities of cement treated base, measured as provided above, will be paid for at the contract unit price for the cement treated base mixture, complete in place, including bituminous curing seal when required, except that an adjustment will be made to

the unit price paid for any lot represented by the mean value of the seven-day compressive strengths as shown in Table 304-1.

TABLE 304-1	
Mean Compressive Strength (Pounds per square inch)	Unit Price Adjustment (dollars per ton)
500 or more	0
450 to 499	- 1.50
400 to 449	- 3.25
350 to 399	- 5.00
Less than 350 *	- 7.00
*Material represented by lots attaining seven-day compressive strengths with a mean value less than 350 pounds per square inch will be evaluated as to acceptance. The Engineer will determine if the material can be left in place. Cement-treated base allowed to remain in place will be subject to the unit price adjustment. Cement-treated base not allowed to remain in place shall be replaced at no additional cost to the Department.	

SECTION 305 LEAN CONCRETE BASE:

305-1 Description:

The work under this section shall consist of furnishing all materials and constructing a lean concrete base in accordance with the details shown on the project plans and the requirements of these specifications.

Lean concrete base shall consist of a mixture of aggregate, hydraulic cement, water and admixtures.

305-2 Materials:

305-2.01 Hydraulic Cement and Water:

Hydraulic cement and water shall conform to the requirements of Subsection 1006-2.

305-2.02 Aggregate:

At the option of the contractor, the aggregate for lean concrete base shall be either Class 2 aggregate base material conforming to the requirements of Subsection 303-2 or a combination of fine and coarse aggregate for Portland cement concrete conforming to the requirements of Subsection 1006-2.03.

When Class 2 aggregate base material is used, it shall have a minimum sand equivalent value of not less than 50 when tested in accordance with the requirements of AASHTO T 176, and the plasticity index requirements presented in Subsection 303-2 will not apply.

When a combination of fine and coarse aggregate is used, the coarse aggregate shall be Standard Size Designation No. 57 conforming to the requirements of AASHTO M 43. Fine aggregate shall have a minimum sand equivalent of not less than 50 when tested in accordance with the requirements of AASHTO T 176.

305-2.03 Admixtures:

Admixtures shall conform to the requirements of Subsection 1006-2.04.

305-2.04 Curing Compound:

Curing compound shall be Type 2, Class A liquid membrane-forming compound conforming to the requirements of Subsection 1006-2.05.

305-3 Construction Requirements:

305-3.01 Preparation of Subgrade, Subbase or Base:

Lean concrete base shall be placed on a prepared subgrade, subbase or base which shall have been constructed in accordance with the surface finish and grade tolerance requirements specified for the material involved.

The subgrade, subbase or base shall be free of loose or extraneous material, kept uniformly moist immediately prior to placement of lean concrete base and maintained in an acceptable condition throughout the placement operation. Any soft or yielding area of the subgrade shall be corrected prior to placement of lean concrete base.

305-3.02 Forming:

Lean concrete base shall be constructed with slip-form equipment. Forming shall conform to the requirements of Subsections 401-3.03(A), 401-3.03(B), and 401-3.03(C).

305-3.03 Proportioning:

(A) Mix Design:

The contractor shall determine the mix proportions and shall furnish lean concrete base which shall contain not less than 275 pounds of hydraulic cement per cubic yard, however, the amount of cement in the mix may be reduced when fly ash is added as hereinafter specified. The lean concrete base shall attain a minimum compressive strength of 500 pounds per square inch at seven days.

The contractor shall submit a complete solid-volume mix design to the Engineer for review prior to incorporating the proposed mix into the work. Mix designs submitted for review shall include the weights and volumes of all ingredients; the brand, type and source of hydraulic cement and admixtures; the aggregate base or the coarse aggregate size number designation; the source of aggregate; the specific gravities of all ingredients; and a code

number to identify the mix design. The contractor may submit mix designs from previous or concurrent projects.

The contractor shall make no changes in the mix designs or code numbers without the review of the Engineer. A new mix design shall be submitted for the Engineer's review any time the contractor proposes a change in materials or material proportions.

The contractor shall prepare trial batches of lean concrete base for each mix design. The number of trial batches required will be established by the Engineer and the Engineer may waive the requirements for trial batches at any time. The contractor shall prepare trial batches using materials, mixing equipment, procedures and batch sizes which are the same as those to be used in the work.

The Engineer will take test samples from the trial batches. When test results indicate the proposed mix will not meet the specified compressive strength requirements, the contractor shall submit a new mix design for review.

In no case will the Engineer's review or test of a mix design relieve the contractor of the responsibility to provide lean concrete base with the specified properties or material contents.

(B) Cement, Water and Aggregates:

Cement, water and aggregate shall be proportioned in accordance with the requirements of Subsections 1006-4.02(A), (B) and (C).

(C) Admixtures:

Admixtures shall be proportioned in accordance with the requirements of Subsection 1006-4.02(D).

Air-entraining admixtures will be required for lean concrete base placed at elevations above 3,000 feet. The amount of entrained air in the lean concrete mixture shall not be less than four percent, nor more than seven percent by volume. At elevations below 3,000 feet, air-entraining admixtures may be used at the option of the contractor; however, the amount of entrained air in the lean concrete mixture shall not exceed seven percent by volume.

An approved water reducing admixture shall be used.

A fly ash admixture may be used at the option of the contractor only when Portland cement is used. A maximum of 20 percent, by weight, of the Portland cement may be replaced with fly ash. A minimum of 1.2 pounds of fly ash shall replace each pound of Portland cement.

305-3.04 Mixing:

Mixing shall be performed in accordance with the requirements of Subsection 1006-4.03.

305-3.05 Consistency:

The contractor shall furnish lean concrete base having a slump of 4.5 inches or less. Lean concrete base that fails to conform to this consistency requirement will be rejected. Tests for consistency will be performed in accordance with the requirements of AASHTO T 119.

305-3.06 Weather Limitations:

Lean concrete base shall be constructed in accordance with the weather limitations of Subsection 1006-5.

305-3.07 Joints:

There shall be no longitudinal or transverse weakened plane joints in lean concrete base. Transverse construction joints shall be constructed normal to center line of the pavement at the end of each day's production and during other work interruptions as directed by the Engineer. When Portland cement concrete pavement is to be placed over lean concrete base, longitudinal construction joints in the lean concrete base shall be at least two feet from any subsequent longitudinal joint in the Portland cement concrete pavement.

305-3.08 Placing and Finishing:

Lean concrete base shall be placed and finished in accordance with the applicable requirements of Subsection 401-3.04 except that Subsection 401-3.04(F), Surface Texturing, is not applicable.

Lean concrete base may be placed either for the full width in a single pass or in two or more passes, provided that each pass is a minimum of 12 feet wide wherever possible. Longitudinal construction joints between passes shall conform to the requirements of Subsection 305-3.07.

The surface of the lean concrete base shall be finished to a smooth floated surface and the surface plane shall not vary by more than 1/8 inch in any direction when measured with a 10-foot straightedge, nor vary by more than 1/4 inch across any construction joint.

305-3.09 Curing:

Curing of lean concrete base shall begin immediately after surface finishing operations. Liquid membrane-forming compound shall be applied to the surface and sides of the lean concrete base at a rate of not less than one gallon per 100 square feet.

The curing compound container shall be equipped with a calibrated sight glass for verification of quantities used.

305-3.10 Production Lot:

The compressive strength and thickness of lean concrete base will be evaluated for each lot of production. A lot shall consist of 4,000 square yards, or fraction thereof, of continuously placed lean concrete base, on a daily basis.

305-3.11 Compressive Strength:

The minimum average compressive strength of lean concrete base shall be 500 pounds per square inch for each lot at seven days. Each lot shall be represented by four random samples. A strength test will consist of the average strength of two cylinders prepared with material taken from a single load of lean concrete base. If any cylinder should show obvious evidence of improper sampling, molding, or testing, it will be discarded and the strength test will consist of the strength of the remaining cylinder. All test cylinders will be prepared in accordance with the requirements of AASHTO T 23. Testing for compressive strength will be performed in accordance with the requirements of Arizona Test Method 314. The mean value of the four compressive strength tests will be reported to the nearest pound per square inch. The unit price paid for the lean concrete base in that lot will be adjusted in accordance with the provisions of Subsection 305-5.

305-3.12 Opening to Traffic:

No traffic or equipment will be permitted on lean concrete base until the material has attained the specified seven-day compressive strength. However, when lean concrete base is to be placed adjacent to previously constructed lean concrete base, the paver and work bridges required for completing the new width will be permitted on the lean concrete base 72 hours after placement.

The contractor shall schedule its operations and route its equipment such that the base is subjected to minimal traffic. When it is necessary for construction traffic to travel on lean concrete base which has attained the specified compressive strength, the traffic shall comply with all legal load restrictions applicable to traffic on state highways. No overloaded vehicles will be permitted to travel on the lean concrete base under any circumstances.

Damage to the curing compound or to the lean concrete base which occurs as a result of the contractor's construction activities shall be promptly repaired by the contractor at no additional cost to the Department, when so directed by the Engineer.

305-3.13 Lean Concrete Base Thickness:

Lean concrete base shall be constructed to the specified thickness. Tolerances allowed for base and subgrade construction and other provisions of the Specifications which may affect thickness shall not be construed to modify the lean concrete base thickness requirements.

To determine thickness acceptability, the contractor shall drill four-inch minimum diameter cores at the locations specified by the Engineer.

The Engineer will determine average core thickness in accordance with the provisions of AASHTO T 148, except that the measurements will be made to the nearest thousandth of

an inch, and the average of the measurements will be reported to the nearest hundredth of an inch.

When calculating average core thicknesses, cores which exceed the specified thickness by more than 0.25 inches will be considered to have the specified thickness plus 0.25 inches.

The Engineer may make field thickness measurements in lieu of measurements in accordance with AASHTO T 148 when an initial core taken from any unit exceeds the specified thickness; however, when the initial core is less than the specified thickness or when there is any question as to the unit thickness, thicknesses will be determined in accordance with AASHTO T 148.

To determine the acceptability of each lot of lean concrete base, the following procedures will be followed:

An initial core shall be drilled in each lot and, if the thickness of the core is not deficient by more than 0.25 inches, the thickness of the lean concrete base in that lot will be considered acceptable.

If the thickness of the initial core is deficient by more than 0.25 inches, but less than or equal to 0.75 inches, two additional cores shall be drilled within that lot and the thickness of the three cores will be averaged. The average of the three cores will be used to determine acceptability, and the unit price paid for the Lean Concrete Base in that lot will be adjusted as specified in Subsection 305-5.

If any core is deficient by more than 0.75 inches, additional cores shall be drilled at intervals not to exceed 10 feet in each direction from the deficient core, parallel to the roadway center line, until one core is obtained in each direction which is not deficient by more than 0.75 inches. The lean concrete base between these two cores will be evaluated separately from the balance of the lean concrete base in that lot, and unless otherwise directed by the Engineer, shall be removed and replaced with lean concrete base of the specified thickness.

At all locations where cores have been drilled, the resulting holes shall be filled with lean concrete base or other similar material as approved by the Engineer.

305-4 Method of Measurement:

Lean concrete base will be measured by the square yard.

305-5 Basis of Payment:

The accepted quantities of lean concrete base, measured as provided above, will be paid for at the contract unit price, complete in place, except that an adjustment to the nearest cent in the contract unit price will be made in accordance with Table 305-1 and Table 305-2, when either the quality of concrete represented by the mean value of the four compressive strength tests is less than the specified seven day compressive strength or

when the average lengths of cores indicates deficiencies in thickness by more than 0.25 inches, but less than or equal to 0.75 inches.

TABLE 305-1 ADJUSTMENT IN CONTRACT UNIT PRICE FOR DEFICIENCY IN THICKNESS OF LEAN CONCRETE BASE	
Average Core Length, Less Than Specified Thickness: Inches	Unit Price Allowed: Percent of Contract
0.00 to 0.25	100
0.26 to 0.35	93
0.36 to 0.45	85
0.46 to 0.55	75
0.56 to 0.75	50
Greater than 0.75 *	25
<p>* Material represented by cores deficient by more than 0.75 inches in thickness and/or represented by lots attaining seven-day compressive strengths with the mean value of the four compressive strength tests less than 350 pounds per square inch will be evaluated as to acceptance. The Engineer will determine if the material can be left in place. Lean concrete base allowed to remain in place will be subject to the unit price adjustments presented in Tables 305-1 and 305-2. Lean concrete base not permitted to remain in place shall be removed and replaced at no additional cost to the Department.</p>	

TABLE 305-2 ADJUSTMENT IN CONTRACT UNIT PRICE FOR DEFICIENCY IN COMPRESSIVE STRENGTH OF LEAN CONCRETE BASE	
Mean Compressive Strength (pounds per square inch)	Unit Price Adjustment ** (dollars per square yard)
500 or more	0
450 to 499	- 1.50
400 to 449	- 3.25
350 to 399	- 5.00
Less than 350 *	- 7.00
<p>* Material represented by cores deficient by more than 0.75 inches in thickness and/or represented by lots attaining seven-day compressive strengths with the mean value of the four compressive strength tests less than 350 pounds per square inch will be evaluated as to acceptance. The Engineer will determine if the material can be left in place. Lean concrete base allowed to remain in place will be subject to the unit price adjustments presented in Tables 305-1 and 305-2. Lean concrete base not permitted to remain in place shall be removed and replaced at no additional cost to the Department.</p>	
<p>** The Unit Price Adjustment will be multiplied by the design thickness of lean</p>	

<p style="text-align: center;">TABLE 305-2 ADJUSTMENT IN CONTRACT UNIT PRICE FOR DEFICIENCY IN COMPRESSIVE STRENGTH OF LEAN CONCRETE BASE</p>
<p>concrete base in inches, the product divided by 10, and rounded off to the nearest 25 cents to determine the unit price for payment.</p>

Where a deficiency exists in both the average length of cores and the average compressive strength, the amount of the contract unit price allowed will be the appropriate percentage of contract unit price allowed from Table 305-1 less the unit price adjustment from Table 305-2.

SECTION 306 GEOGRID BASE REINFORCEMENT:

306-1 Description:

The work under this section shall consist of furnishing and placing a geogrid material within or below the aggregate base as shown on the project plans.

306-2 Materials:

306-2.01 Geogrid Materials:

The geogrid material shall be supplied in accordance with and conform to the material requirements of Subsections 1014-1 and 1014-3.

306-2.02 Geogrid Packaging, Handling, and Storage:

The identification, packaging, handling, and storage of the geogrid material shall be in accordance with ASTM D 4873. Geogrid rolls shall be furnished with suitable wrapping for protection from the elements, primarily ultraviolet exposure, prior to placement. Each roll shall be labeled or tagged to provide product identification sufficient to determine the product type, manufacturer, quantity, lot number, roll number, date of manufacturer, shipping date, and the project number and name to which it is assigned. Rolls will be stored on the site or at another identified storage location in a manner which protects them from the elements, and any other factor which may cause damage to the material. Care should be taken to prevent mud, wet cement, epoxy and other contaminating materials which may permanently affix themselves to the grid material, from coming into contact with the geogrid. If stored outdoors, geogrid rolls shall be elevated and protected with a light colored, opaque, waterproof cover. At no time shall the geogrid material be exposed to ultraviolet light for a period exceeding 14 days or stored in temperatures below zero degrees F or in extreme heat. Torn, damaged, or defective geogrid will be rejected.

306-3 Construction Requirements:

306-3.01 Weather Limitations:

The geogrid shall not be placed when weather or surface conditions, in the opinion of the Engineer, are not suitable for placement. This will normally be at times of wet and snowy conditions, heavy rainfall, extreme cold or frost conditions, or extreme heat.

306-3.02 Equipment:

Mechanical or manual laydown equipment shall be capable of laying the geogrid properly and smoothly, according to the manufacturer's recommendations.

306-3.03 Surface Preparation:

If the geogrid material is to be placed directly on the subgrade, the subgrade surface shall be compacted and finished according to Subsections 203-3.03, 203-10.03, or 205-3.04 prior to placement of the geogrid. If the geogrid material is to be placed within the aggregate base materials, the aggregate base surface upon which the geogrid will be placed, shall be compacted according to Subsection 303-3.02 and finished according to Subsection 303-3.03 before placement of the geogrid.

306-3.04 Geogrid Placement:

The geogrid shall be rolled out along the alignment in the direction of advancing construction. All wrinkles and folds shall be removed.

A 12-inch minimum overlap with securing pins is required at all joints (both transverse and longitudinal). Longitudinal joints shall be located according to the requirements shown in Subsection 406-6 for pavement joints unless otherwise approved by the Engineer. At transverse joints, the preceding roll shall overlap the following roll in the direction that the aggregate base will be placed. Securing pins shall be 3/16-inch steel bars, pointed at one end and fabricated with a head to retain a steel washer having an outside diameter of not less than 1.5 inches. U-shaped pins shall be another option as approved by the Engineer.

The length of the securing pins shall be four-inch minimum. The geogrid shall be tensioned by hand and anchored to the ground at the edges, including overlaps, and in the center of the roll at 30-foot intervals along the roll length, at the corners if applicable, or as directed by the Engineer. The use of securing pins may be reduced or eliminated by the Engineer if it can be shown that by careful installation the geogrid is adequately tensioned by hand and anchored by the placed aggregate in a progressive installation process as recommended by the manufacturer's representative.

Care shall be taken to ensure that geogrid sections do not separate at overlaps during construction. Placement of geogrid around corners will require cutting of the geogrid product and diagonal overlapping of the same to make sure that excessive buckling of geogrid material does not occur.

306-3.05 Placing and Compacting Aggregate Fill:

The aggregate shall be back dumped and spread in a uniform lift maintaining the design aggregate thickness at all times. The aggregate material shall be bladed onto the geogrid

in such a manner that the aggregate rolls onto the grid ahead, by gradually raising the dozer blade while moving ahead.

If the underlying material is capable of supporting rubber tire trucks (end and belly dumps) they may drive over the grid at very low speeds, less than five miles per hour, and dump aggregate as they go. Sudden stops and turning by trucks shall be avoided while on the grid. No tracked vehicles should be allowed on the grid until there is a minimum of six inches of material between the tracks and the grid.

Any ruts which might develop during spreading or compacting the aggregate shall be filled with additional aggregate rather than bladed from surrounding areas. Placing additional aggregate into the rutted areas insures that the design aggregate thickness is maintained.

Geogrid damaged after or during construction will be repaired in accordance with the manufacturer's recommended procedure.

Aggregate base shall be compacted as specified in Subsection 303-3.02. Aggregate base material shall not be mixed or processed on the geogrid. The aggregate base material shall be premixed at the stockpile area or another location in a manner approved by the Engineer. Aggregate base materials will be sampled for acceptance after premixing and prior to placement on the geogrid material. Contamination and segregation of aggregate base materials prior to or during placement shall be minimized.

306-4 Method of Measurement:

Geogrid base reinforcement will be measured by the square yard in-place. Measurement will be to the nearest square yard. No allowance will be made for material in laps.

306-5 Basis of Payment:

The accepted quantity of geogrid base reinforcement, measured as provided above, will be paid for at the contract unit price per square yard, which price shall be full compensation for furnishing all labor, material, and equipment, and performing all operations in connection with placing the geogrid as shown on the project plans. No payment will be made for geogrid base reinforcement rejected due to either contamination or damage due to either the fault or negligence of the contractor.

SECTION 307 GEOCOMPOSITE EDGE DRAIN:

307-1 Description:

The work under this section shall consist of furnishing all labor, equipment, and materials to install a pavement edge drain system. The drainage system shall be installed in accordance with the specifications, plans, and manufacturer's recommendations. The purpose of the geocomposite edge drain is to provide drainage for the pavement base course while restricting loss of fines.

307-2 Materials:

307-2.01 Geocomposite Edge Drain:

The geocomposite edge drain material shall be supplied in accordance with and conform to the material requirements of Subsections 1014-1 and 1014-7.

307-2.02 Geocomposite Packaging, Handling, and Storage:

The identification, packaging, handling, and storage of the geocomposite edge drain material shall be in accordance with ASTM D 4873. Geocomposite edge drain material shall be furnished in rolls, or in another acceptable manner wrapped with a suitable protective covering to protect the fabric from mud, dirt, dust, debris, or harmful ultraviolet light. The edge drain material shall be free of defects or flaws which significantly affect its physical properties at the time of delivery and installation. Each roll or package shall be labeled or tagged to provide product identification sufficient to determine the product type, manufacturer, quantity, lot number, roll number, date of manufacture, shipping date, and the project number and name to which it is assigned. Geocomposite edge drain materials shall be stored on the site or at another location approved by the Engineer in a manner which protects them from the elements. If stored outdoors, the materials shall be elevated and protected with a light colored, opaque, waterproof cover. At no time shall the edge drain material be exposed to direct sun light for a period exceeding 14 days.

307-3 Construction Requirements:

307-3.01 Weather Limitations:

The geocomposite edge drain shall not be placed when weather conditions, in the opinion of the Engineer, are not suitable to allow placement or installation. This will normally be at times of wet and snowy conditions, heavy rainfall, extreme cold and frost conditions, or extreme heat.

307-3.02 Equipment:

Trenching equipment shall be capable of excavating the necessary trenches for the edge drain and outlet pipes. Mechanical or manual equipment shall be capable of properly installing the edge drain and lateral outlet pipes, and backfilling according to the specifications, plans and manufacturer's recommendations.

307-3.03 General:

The contractor will not be allowed to begin installation of the edge drain system unless a representative of the edge drain manufacturer or supplier is present. The edge drain is to be placed in accordance with the manufacturer's recommendations in a trench having the dimensions as shown on the plans or as required by the manufacturer and approved by the Engineer.

307-3.04 Construction Method:

The trenches for the edge drain and necessary lateral outlet pipes shall be neatly cut through existing materials to the lines and dimensions shown on the plans or as recommended by the manufacturer and approved by the Engineer. The trenching method shall normally be by use of wheel cutter trenching equipment although an alternative method may be approved by the Engineer. The edge drain material including lateral outlet pipes, shall be placed in accordance with the plans and the manufacturer's recommendations. The edge drain shall be placed so that the fabric on one side is in intimate contact with the aggregate base materials. It may be necessary to use spacers or blocks to keep the edge drain up against the aggregate base during backfilling. The trench with the edge drain in place may be backfilled with minus-two-inch material that was excavated from the trench, provided that sharp rocks or other material which, in the opinion of the Engineer may damage the fabric, are removed.

The soil backfill shall be placed in lifts not to exceed six inches of compacted depth with the backfill compacted to a density not less than 95 percent of the maximum density as determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer. Care shall be taken during compaction to prevent damage to the edge drain material or lateral pipes. The final two inches of the edge drain trench shall be filled with hot asphaltic concrete, meeting the material requirements of Section 409, and compacted. The amount of trench excavated at any time shall not exceed the amount of pavement edge drain system which can be installed and the backfill completed in one working day. Backfill must be placed to the top of the edge drain trench if the asphaltic concrete will not be placed in the same working day.

All necessary splices and connections are to be made with kits furnished by the manufacturer and in accordance with the manufacturer's specifications and directions.

307-3.05 Damage to Pavement:

The contractor shall not damage the adjacent existing pavement during the excavation and placement operation. Any damage done to the pavement shall be repaired, at no additional cost to the Department, in a method approved by the Engineer.

307-4 Method of Measurement:

Geocomposite edge drain will be measured by the linear foot in-place. Measurement will be to the nearest foot. No allowance will be made for laps or lateral pipes.

307-5 Basis of Payment:

The accepted quantity of geocomposite edge drain, measured as provided above, will be paid for at the contract unit price per linear foot, which price shall be full compensation for furnishing all labor, material and equipment and performing all operations in connection with installing the geocomposite edge drain as shown on the project plans. No payment will be

made for geocomposite edge drain rejected due to either the fault or negligence of the contractor.